Final Project Report

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General Investment Philosophy

The investment philosophy of this fund is to provide clients with positive returns on what the fund considers to be relatively "safe" investments. The assets chosen for the fund's portfolio are four ETFs: SPY, TLT, VTI, and QQQ. The initial philosophy of the fund was to implement a buy-and-hold strategy, and simply ride the market for a few decades before cashing in on our assets. However, upon the fund's research, it has been decided that a momentum strategy with monthly rebalancing is the best way to optimize our portfolio, and therefore maximize the client's returns.

The work of professors Rohnn Sanderson and Nancy L. Lumpkin-Sowers lays the foundation for the switch from buy-and-hold to alternative methods. Their work experiments with buy-and-hold strategies specifically with ETFs, and compares the performance with algorithmic trading strategies. They found through their experiments that with their data, it takes exactly 10 years for a client to see a 100% return on their initial investment. Sanderson and Lumpkin-Sowers point out that a buy-and-hold strategy given the current volatile nature of the stock market is obsolete because average modern investors are less likely to hold for the length of time necessary to be profitable, especially during the downs of today's market (2018).

The fee philosophy of the fund is to charge appropriate fees that will allow the fund to continue to be viable in the long-run, but to always take into consideration fairness and responsibility for our clients. There are three metrics that are pertinent to our fee structure and they are as follows:

1. Annual Management Fee - A fee of 1% charged annually for as long as the portfolio is actively managed by the fund for the client
2. Initial Investment Fee - A fee of 1% charged as the upfront cost for going into business with the fund and for the clients portfolio to be managed by our employees
3. Performance Fee - A fee of 5% charged annually when portfolio performance crosses the Alpha threshold hurdle-rate of 8% as this is the fund's Average Annual Return.

Investment Methods / Rules Employed

The momentum strategy employed structurally embodies Clenow's momentum strategy seen in his work *Trading Evolved: Anyone Can Build Killer Trading Strategies in Python.* The objective of Clenow's strategy and the fund's investment philosophy is long-term stable performance (2019) . The rules of the momentum protocol are as follows:

- Trading is only done monthly, with the investor rebalancing and repeating the process after each month
- Momentum slope is calculated using a 125-day window
- Weights will be calculated for my assets using inverse volatility
- Volatility itself is derived from 20-day standard deviation
- The trend filter is calculated based on a 200-day average of the S&P index
- If the trend filter is positive, investor is allowed to buy
- Minimum required momentum value is set to 0.00001. If the assets have a value higher than 0.00001 then the investor buys. If an asset in the portfolio falls below the minimum value, or it leaves the index during the time period, the investor sells

Description of Securities

As stated earlier, the four securities that are included in the fund are four ETFs: SPY, TLT, VTI, and QQQ. The SPY is an ETF that tracks the S&P 500 index, TLT is used for Treasury Bonds, VTI is the Vanguard Total Stock Market, and QQQ tracks the NASDAQ Top 100. The QQQ ETF was added to the fund to be a high-growth asset. Through backtesting and analysis, the fund found that QQQ can increase the client's ROI albeit adding more risk and volatility over the 20-year trading period.

The aforementioned Sanderson and Lumpkin-Sowers write that "When an ETF fails, it quietly disappears from the marketplace, and clients' funds are generally rolled into something else. This means that there are only a handful that stay around over the long haul and the results of those remaining look pretty good" (2018). We have 20 years of solid historical data for our ETFs, giving us confidence that

SPY, TLT, VTI, and QQQ are healthy and stable funds to include into the portfolio given Sanderson and Lumpkin-Sowers' observation.

It should also be noted that all of our securities are set against the backdrop of the S&P 500 (SPX). We use the S&P as a benchmark to evaluate the performance of our specific assets and portfolio as a whole in relation to the market over the set trading period.

Performance Evaluation

The investment methods and rules play out rather well on our generated data. We expect our clients to see strong returns with a relatively low amount of risk. Building from Checkpoint C, the three metrics that are most important for evaluating the fund's performance are Average Annual Returns (Alpha), Sharpe Ratio, and Max Drawdown. Alpha is an important metric since it gives an idea of returns relative to the market over our trading period. Sharpe Ratios are vital because they essentially measure the efficiency of our investments in relation to the amount of risk our clients are taking on. Finally, Max Drawdowns will show us that when an inevitable dip in the market occurs, how bad can we expect our losses to be? Below is a table comparing these metrics for each of the fund's experiments:

Baseline Portfolio	Revised Portfolio + No Fees	Revised Portfolio + Fees (Final Portfolio)	S&P 500 Benchmark
Alpha = 3.8% Return	Alpha = 8.1% Return	Alpha = 6.9% Return	Alpha = 8.4%
Sharpe Ratio = 0.4503	Sharpe Ratio = 0.6664	Sharpe Ratio = 0.5890	Sharpe Ratio = 0.4369
Max Draw = 0.0892	Max Draw = 0.1917	Max Draw = 0.1999	Max Draw = 0.2002

The Baseline Portfolio – consisting of SPY, TLT, and VTI – had a meager 3.8% return, but on the upside came with a very low Max Drawdown of 0.0892. This told the fund that our initial portfolio was too risk-averse. It never experienced horrible losses, but it also never generated the returns our clients

were looking for. This caused a shift in fund philosophy as we wanted to generate more growth for the portfolio and became more accepting of higher volatility.

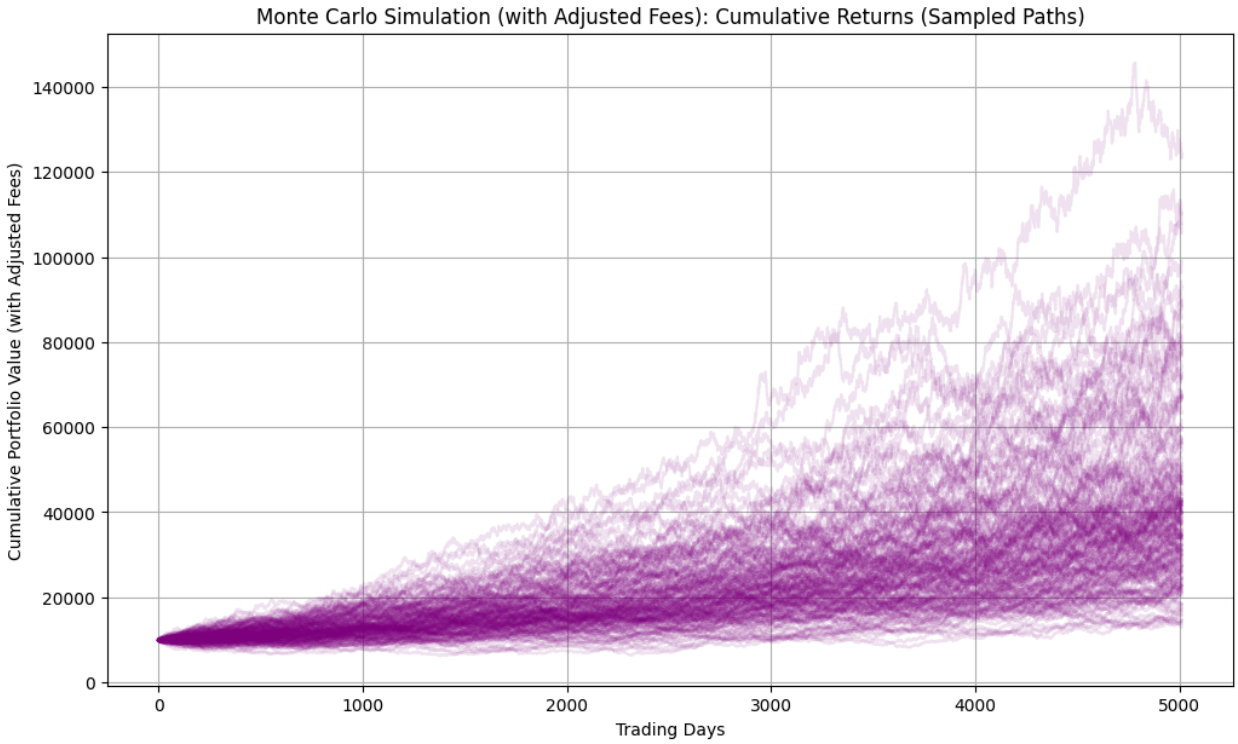
The Revised Portfolio is when the QQQ was included. The initial baseline was tested against the QQQ as a benchmark and showed the fund that perhaps if QQQ was included, it could be a high-growth asset. As one can see, this turned out to be true. Our Alpha metric skyrocketed to 8.1%, nearing the S&P benchmark of 8.4%. Adding QQQ also increased our Sharpe Ratio significantly. Of course, this comes with greater volatility and therefore a higher Max Drawdown, but as stated before, the fund was willing to take this on if it was worthwhile in generating higher returns. However, this portfolio is not viable given that there are no fees introduced for the fund to manage operations.

The third portfolio is our fee-adjusted portfolio, or rather, the final portfolio for the fund. This is when the fund's fee structure outlined in the General Investment Philosophy section is applied to the portfolio and client's fees are taken into account. Naturally, we expect these numbers to be less than the Revised Portfolio where there are no fees introduced, rather just an additional asset in QQQ. Still, the portfolio sees an almost 7% return and maintains a higher Sharpe Ratio than the risk-averse Baseline Portfolio while again increasing Max Drawdown.

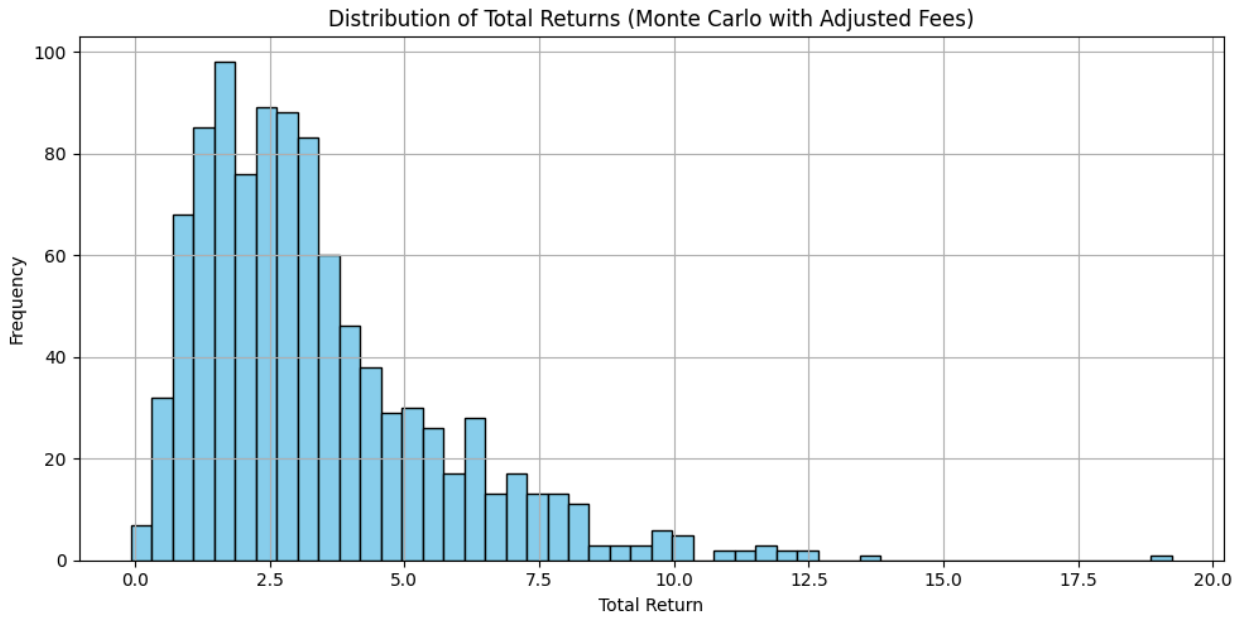
The next step for the fund was to evaluate possible outcomes for our portfolio given the management fee structure required for daily operation. For this, two Monte Carlo simulations were performed, 1000 times each, to test the distributions and outcomes of our portfolio with a starting principal investment of $10,000.

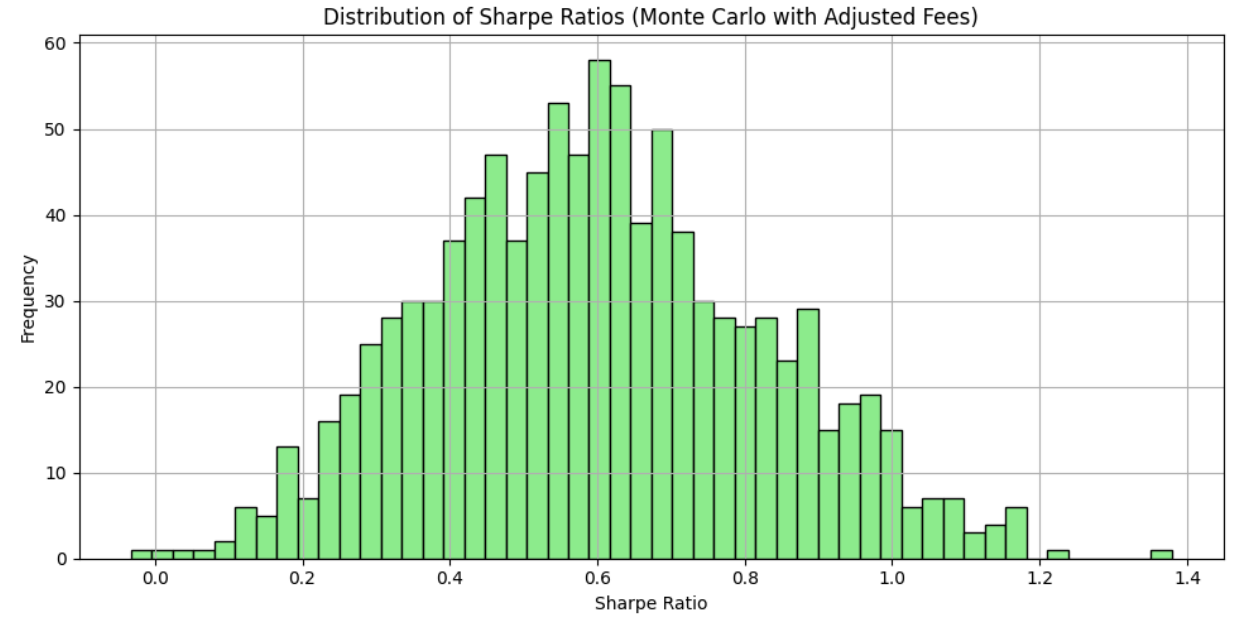
Monte Carlo Before Fees	Monte Carlo After Fees
Alpha = 8.3% Return	Alpha = 7.1% Return
Sharpe Ratio = 0.6855	Sharpe Ratio = 0.5984
Max Drawdown = 0.2732	Max Drawdown = 0.2765

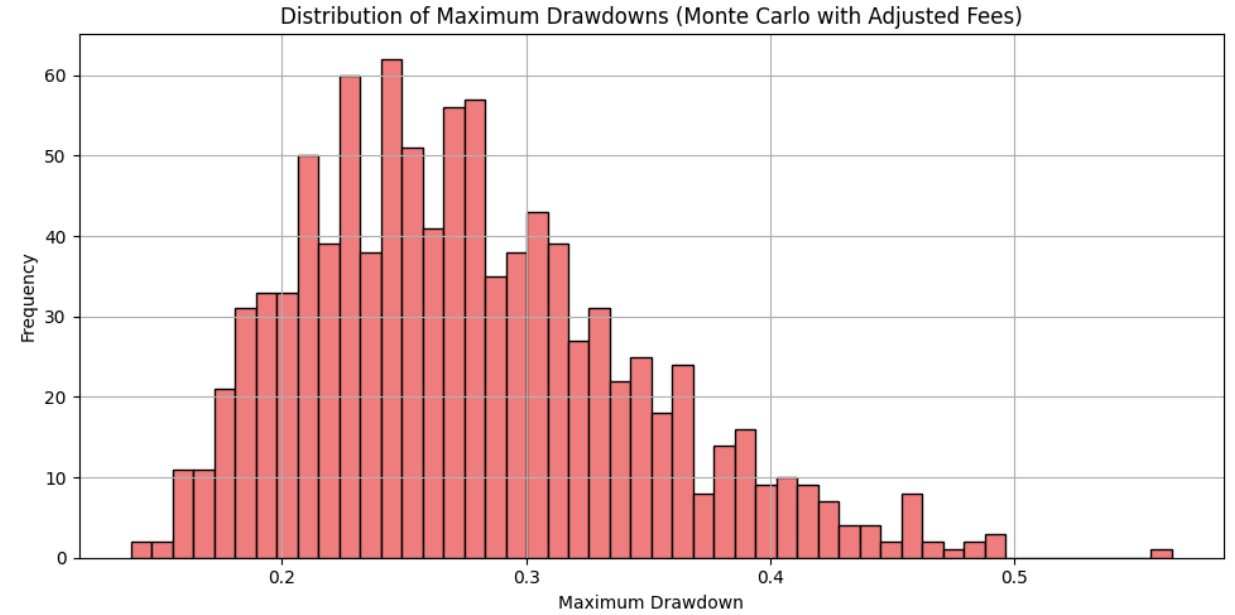
The simulation results show that our final portfolio with our fee structure still generates an adequate 7.1% Average Annual Return compared to the 8.4% benchmark of the S&P. The higher Max Drawdown statistic is expected as the simulation is going to take into account random events that may cause a decline in the market. As it pertains to our clients, the portfolio distributions are vital to understanding the possible outcomes for their investment:



This path plot shows the possible random growth paths for the portfolio. As one can see, a large concentration of these show positive increases in cumulative value for the portfolio. This is highlighted by the dark purple paths. Below are the given distributions derived from the simulation. These plots can be presented to our clients in a transparent matter to give them a forecast of the types of outcomes they can expect to see with the fund:


Distribution of Total Returns (Monte Carlo with Adjusted Fees)
Frequency
Total Return
0
20
40
60
80
100
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0


Distribution of Sharpe Ratios (Monte Carlo with Adjusted Fees)
Frequency
Sharpe Ratio
0
10
20
30
40
50
60
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4

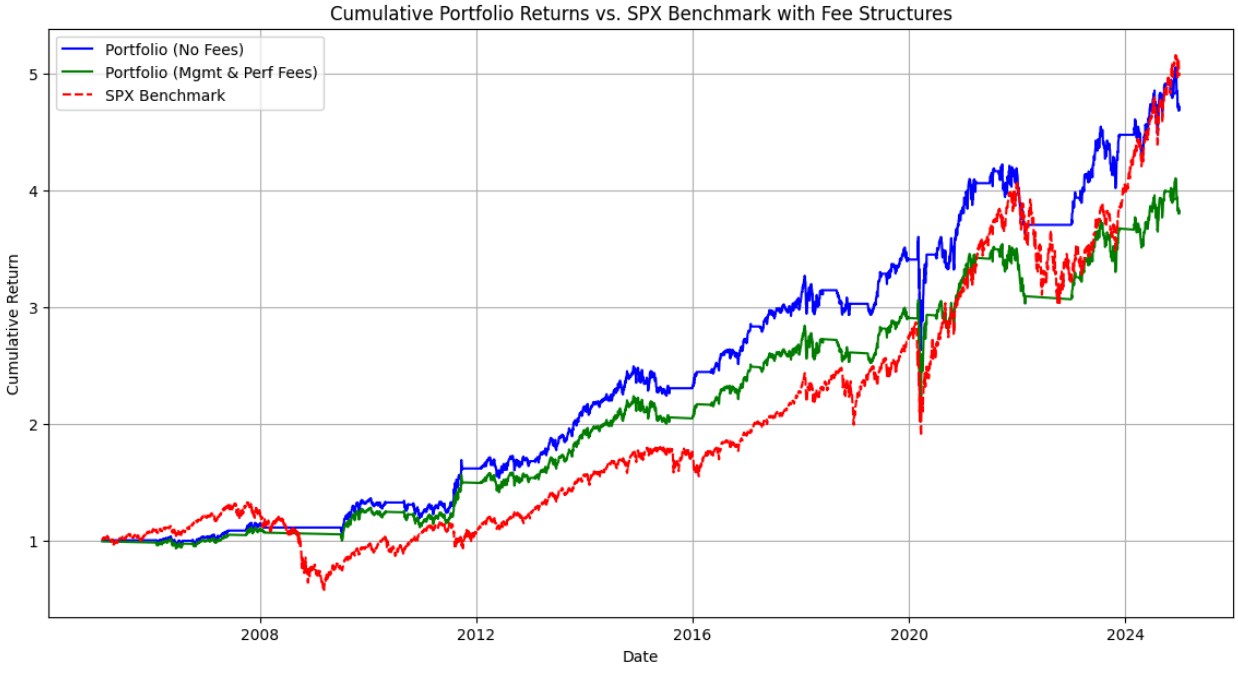

Distribution of Maximum Drawdowns (Monte Carlo with Adjusted Fees)
Frequency
Maximum Drawdown
0
10
20
30
40
50
60
0.2
0.3
0.4
0.5

Based on the Total Return distribution, the results showing a 10x return on the initial value are outliers, and should not be expected as an average. It is a good sign that little to none of the simulations produced negative or break-even returns. It is fair to say that in terms of frequency, odds are that we can expect to see at least a double-up on the initial investment value, in this case, $10,000.

The bell-curve nature of the Sharpe Ratio distributions is promising as well. This gives the fund confidence in the stability of the returns on investment given its associated risk. When it comes to the Max Drawdown, we also see some stability as the majority of simulations result in a value between 0.2 and 0.3. The fact that we see the frequency of portfolios decrease as Max Drawdown increases gives clients the sign that they won't experience extreme losses on their investment were the market to be in turmoil due to an unforeseen event.

Management Recommendation

I personally believe this management firm should be started. I think that there is sufficient testing on the 20-year historical data to support this belief. If you examine the plot below:



The portfolio clearly finds the middle ground between the market benchmark and an ideal portfolio with no fees. Obviously, operating without any fees is not feasible and applicable to the real-world. For a solid decade, our portfolio was even outperforming the SPX benchmark until COVID-19. Even though the portfolio did not experience as big of a Max Drawdown as SPX, we have not seen the recovery from the pandemic that SPX has. My only concern would be in a post-COVID world how the fund may perform compared to the market benchmark.

If this firm were to be initiated and I were employed, I'd like to be a researcher. I think doing analysis and researching trends and different trading strategies was not only rather enjoyable, but provides invaluable insight into investing. This kind of thorough testing is important because in real life, the firm would be handling everyday individuals' money. While a steep decline or loss means one thing on a graph, when it comes to people's dollars it could have dire consequences. I don't think financial services firms can operate without data scientists and analysts doing extensive market research and drawing conclusions from historical data.

Personally, I would have become an investor in the Baseline Portfolio. I would classify myself as rather risk-averse when it comes to financial matters. I would prefer low, but stable growth over aiming to generate excess returns with added volatility. If I were investing for personal wealth I'd still invest in this firm. Some may be concerned with the post-COVID returns not outperforming the SPX benchmark, but I believe there's limited data as we're only a few years removed. Additionally, I think the much more telling sign is where the ETFs are from where the historical data starts. They've only grown with time, and ETFs in general I feel are becoming more popular for the modern investor, especially due to low transaction costs, thus making this particular fund an attractive proposition.

References

Clenow, Andreas F. 2019. *Trading Evolved: Anyone Can Build Killer Trading Strategies in Python.* Independently Published. [ISBN-13: 978-1091983786] Author's website: Trading Evolved – Following the Trend

Sanderson, Rohnn, and Nancy Lumpkin-Sowers. "Buy and Hold in the New Age of Stock Market Volatility: A Story about ETFs." *International Journal of Financial Studies*, vol. 6, no. 3, 6 Sept. 2018, p. 79, https://doi.org/10.3390/ijfs6030079. Accessed 13 Oct. 2025.